

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY



(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 04 AUG 2005

WIPO

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Applicant's or agent's file reference MH/P00676WO		<b>FOR FURTHER ACTION</b>		See Form PCT/PEA/416
International application No. PCT/GB2004/001596		International filing date (day/month/year) 13.04.2004	Priority date (day/month/year) 10.04.2003	
International Patent Classification (IPC) or national classification and IPC H01S5/068				
Applicant UNIVERSITY COLLEGE LONDON et al.				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 7 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 3 sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input checked="" type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand  08.11.2004		Date of completion of this report  03.08.2005		
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer  Lendroit, S  Telephone No. +49 89 2399-7637 		

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/GB2004/001596

**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-7 as originally filed

**Claims, Numbers**

1-10 as originally filed

**Drawings, Sheets**

1/7-7/7 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing *(specify)*:
  - ☐ any table(s) related to sequence listing *(specify)*:
4. ☒ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☒ the claims, Nos. 1-17
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing *(specify)*:
  - ☐ any table(s) related to sequence listing *(specify)*:

\* If item 4 applies, some or all of these sheets may be marked "superseded."

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	
	No: Claims	1-2
Inventive step (IS)	Yes: Claims	
	No: Claims	1-10
Industrial applicability (IA)	Yes: Claims	1-10
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

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**Re Item I.**

**Basis of the report**

Amendments have been filed with the International Bureau under Article 19(1) PCT (new amended claims 1-17).

The International Preliminary Examining Authority considers that these amendments introduce subject-matter which extends beyond the disclosure in the international application as filed contrary to the requirements of **Article 19(2) PCT** for the following reasons:

The following features are not expressly or inherently presented in the application as filed:

"Such controller not requiring the use of any synchronous modulation or detection technique" in independent claim 1 and all its dependent claims.

"A tunability range of 8nm" in claims 5,7.

"A tunability range of 40nm" in claims 8,10,12.

"A long phase adjustment section in excess of 0.5mm" in claims 6,9,11,13.

Therefore according to Rule 70.2(c) PCT the International Preliminary Examination Report is established as if these amendments have not been made.

**Re Item V.**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

The following documents are referred to in this communication; the numbering will be adhered to in the rest of the procedure:

D1: GB 2 381 121 A

D2: US2003/007526 A1

D3: US2001/017876 A1

D4: EP 0 516 398 A

1. Independent claim 1 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined:

- 1.1 The expression "section currents/voltage" is unclear and not precisely defined and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of claim 1 unclear. It is not clear which section this expression refers to.
- 1.2 The following feature "taking into account the laser's output wavelength dependency on temperature and section currents/voltage" in the apparatus claim 1 is defined in terms of a method step instead of clearly defining the apparatus in terms of its technical features. The intended limitations are therefore not clear from this claim, contrary to the requirements of Article 6 PCT.
- 1.3 The following expression "whereby the output wavelength may be kept at the desired operating values without any significant mode jump whatever the temperature of operation within the laser's operative range" attempts to define the subject-matter of independent claim 1 in terms of the result to be achieved, which merely amounts to a statement of the underlying problem, without providing the technical features necessary for achieving this result.  
The laser of independent claim 1 should have been defined in terms of its technical features to meet the requirements of Article 6 PCT.
- 1.4 The expressions "the currents" and "the voltages" are unclear because they have no well defined antecedent. It should have been mentioned which currents and voltages these expressions refer to.
2. Furthermore, the above-mentioned lack of clarity notwithstanding, the present application does not meet the requirements of Article 33(1) PCT, because the subject-matter of independent claim 1 is not new in the sense of Article 33(2) PCT.  
  
Documents D2 and D3 anticipate the subject-matter of claim 1.
3. Furthermore, the above-mentioned lack of clarity notwithstanding, the present application does not meet the requirements of Article 33(1) PCT, because the

subject-matter of independent claim 1 does not involve an inventive step in the sense of Article 33(3) PCT:

Documents D4 (abstract, claim 1) discloses "a tuneable LED apparatus comprising a tuneable LED, a thermal sensor and a controller, said controller controlling at least one or a combination of the following variables: the currents, the voltages, a tuning section, and a phase section; and incorporating means which adjust any appropriate one or a combination of said variables taking into account the laser's output wavelength dependency on temperature and section currents/voltage, whereby the output wavelength may be kept at the desired operating value without any significant mode jump whatever the temperature of operation within the laser's operative range".

The subject-matter of claim 1 differs from the apparatus of D4 in that the light emitting element which is comprised in the apparatus is a laser instead of a LED. However, replacing an LED by a laser diode is an obvious design possibility for the person skilled in the art, depending on the operational requirements. Therefore the skilled person would arrive at the subject-matter of claim 1 without the use of inventive skills.

4. Dependent claim 2 does not contain any features, which in combination with the features of any claim to which it refers, meet the requirements of the PCT in respect of novelty:

Documents D2 and D3 disclose the additional feature of claim 2 (no closed loop temperature control means).

5. Dependent claims 2-10 do not appear to contain any feature, which in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step:

- 5.1 Document D4 discloses the additional feature of claim 2 (no closed loop temperature control means).

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- 5.2 The use of a low pass filter for removing rapidly changing signals (claim 3) is of common practice in the field of feedback regulation.
- 5.3 The choice of the laser type between DBR laser, DFB laser, SG-DBR laser, SSG-DBR laser and vertical cavity filter laser (claims 4-8) is an obvious design possibility which lies in the expertise of the skilled person, depending on the operational requirements.
- 5.4 The additional features of claims 6-10 do not appear to solve any particular problem in an inventive way (tunability mapping in controllers and use of wavelength control signals are disclosed in documents D2, D3, D4).

CLAIMS

1. A wavelength stabilisation system for a tuneable laser comprising:
- i) A tuneable semiconductor laser;
  - 5 ii) - A thermal sensor to sense the laser temperature; - - - - -
  - iii) A controller that utilises the previously determined relationship between laser output wavelength, the laser temperature and the bias applied to those parts of the laser responsible for its tuning characteristics;
- 10 wherein the controller determines values for the bias to be applied to one or more of those parts of the laser responsible for its tuning characteristics in such a manner as to generate an optical signal of highly stable wavelength in the presence of variations in ambient temperature, such controller not requiring the use of any synchronous modulation or detection technique.
- 15
2. A wavelength stabilisation system as in claim 1, in which the controller determines the value(s) of one or more current sources which are applied to one or more of those parts of a laser that control the laser output wavelength by carrier injection.
- 20
3. A wavelength stabilisation system as in claim 1, where the controller determines the value(s) of one or more voltage sources which are applied to one or more of those parts of a laser that control the output wavelength of the laser by applied electric field.
- 25
4. A wavelength stabilisation system as in claim 1, where the output wavelength is maintained independent of laser temperature and without mode jump through control of bias applied to a laser phase adjustment section based upon prior knowledge of the dependence of side mode suppression ratio on laser temperature and phase adjustment section bias.
- 30
5. A wavelength stabilisation system as in claim 1, where the laser is a Distributed Bragg Reflector (DBR) tuneable laser diode comprising three sections one for the laser gain, one for the laser phase and one for the grating (laser tuning section) with a typical operating temperature range of 0 to 70°C and a typical tuneability range of 8nm.



6. A wavelength stabilisation system as in claim 5, where the DBR laser has a long phase adjustment section typically in excess of 0.5mm to allow control of the phase over the full operating range of temperature.

5.

7. A wavelength stabilisation system as in claim 1, where the laser is a Distributed Feed Back (DFB) tuneable laser diode comprising two or more sections with a typical operating temperature range of 0 to 70°C and a typical tuneability range of 8nm.

10 8. A wavelength stabilisation system as in claim 1, where the laser is a Sampled Grating Distributed Bragg Reflector (SG-DBR) tuneable laser diode with a typical operating temperature range of 0 to 70°C and a typical tuneability range of 40 nm.

15 9. A wavelength stabilisation system as in claim 8, where the SG-DBR laser has a long phase adjustment section typically in excess of 0.5 mm to allow control of the phase over the operating range of temperature.

20 10. A wavelength stabilisation system as in claim 1, where the laser is a Super Structure Grating Distributed Bragg Reflector (SSG-DBR), tuneable laser diode with a typical operating temperature range of 0 to 70°C and a typical tuneability range of 40nm.

25 11. A wavelength stabilisation system as in claim 10, where the SSG-DBR laser has a long phase section typically in excess of 0.5 mm to allow control of the phase over the full operating range of temperature

30 12. A wavelength stabilisation system as in claim 1, where the laser is a vertical cavity filter laser with a typical operating temperature range of 0 to 70°C and a typical tuneability range of 40nm

13. A wavelength stabilisation system as in claim 12, where the vertical cavity filter laser has a long phase section typically in excess of 0.5 mm to allow control of the phase over the full operating range of temperature.

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14. A wavelength stabilisation system as in claim 1 where the laser is an external cavity semiconductor laser tuned by the application of bias to one or more external cavity elements.

5. 15. A wavelength stabilisation scheme as in claim 1 where the laser is a vertical-cavity surface emitting laser.

10 16. A frequency referenced coolerless laser diode combining a wavelength stabilisation system according to any of the preceding claims with an optical phase lock loop (OPLL).

17. A frequency referenced coolerless laser diode combining a wavelength stabilisation system according to any of the preceding claims with an optical injection phase lock loop system (OIPLL).

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